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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte JONATHAN E. LIGHTNER, FEDERICO VALVERDE, and STEVEN L. WRIGHT

Appeal 2018-000866
Application 12/780,066
Technology Center 1600

Before JEFFREY N. FREDMAN, DEBORAH KATZ, and JOHN G. NEW, *Administrative Patent Judges*.

FREDMAN, *Administrative Patent Judge*.

DECISION ON APPEAL

This is an appeal[1,2] under 35 U.S.C. § 134(a) involving claims to predicting characteristics of a plant based on spectral data. The Examiner rejected the claims as directed to patent-ineligible subject matter and obvious. We have jurisdiction under 35 U.S.C. § 6(b). We AFFIRM.

[1] Appellants identify the Real Party in Interest as Pioneer Hi-Bred International, Inc. (*see* Supp. App. Br. 1).
[2] We have considered and herein refer to the Specification of May 14, 2010 ("Spec."); Final Office Action of Feb. 10, 2017 ("Final Act."); Appeal Brief of July 5, 2017 ("App. Br."); Examiner's Answer of Sep. 5, 2017 ("Ans."); and Reply Brief of Nov. 1, 2017 ("Reply Br.").

Statement of the Case

Background

"Remote sensing usually refers to the use of imaging sensor technology. The imaging sensor can involve passive collection to detect natural energy (e.g., radiation) that is emitted or reflected by the object or surrounding area being observed" (Spec. ¶ 77). "Application of remote sensing data for plant breeding and plant advancement experiments has centered on classical modeling relative to phenotypes of interest." (Spec. ¶ 11).

"Classical" or "reverse" predictive modeling "starts with certain *a priori* information and/or assumptions (e.g., that a plant's spectrum taken at a certain wavelength is indicative of the plant's yield because of a certain reflective parameter of chlorophyll) and then goes back (i.e., 'reverses') and builds a model based on the assumptions" (Spec. ¶ 5). "[R]everse or classical modeling requires the time and resources to come up with functions relating inputs needed to make a prediction. The processes to identify those functions can be laborious." (Spec. ¶ 9). Also, "classical or reverse modeling may not take into account, and may completely miss, important factors involved in leaf chlorophyll concentration" (Spec. ¶ 10).

"[T]he general inverse method is a different approach from classical or reverse modeling approaches . . . . Multivariate analysis provides reliable prediction of needed information at the right time for acceptable cost from indirect observation measurements even despite selectivity problems, interference, and mistakes" (Spec. ¶¶ 177–178)

The Claims

Claims 1–32 are on appeal. Independent claim 1 is representative and reads as follows:

1. A method of estimating a plant characteristic, comprising:

> a. using a computer processor, constructing a predictive model for the plant characteristic,
>
> the predictive model comprising a calibration constructed from:
>
> > i. a first set of whole-plant spectroscopic absorbance data from a first plant population, and
> >
> > ii. a corresponding measured plant characteristic data set from the first plant population, and,
>
> the calibration being a multivariate relation between the whole-plant spectroscopic absorbance data and the measured plant characteristic data set, the multivariate relation maximizing covariance between the first set of whole-plant spectroscopic absorbance data and the measured plant characteristic data set; and,
>
> b. applying the predictive model to a second set of whole-plant spectroscopic data from a second plant, a second plant population, or both, so as to estimate the plant characteristic in the second plant, the second plant population, or both, and
>
> c. selecting or removing the second plant for use in a plant breeding program based on the second plant's estimated plant characteristic.

The Rejections

A. The Examiner rejected claims 1–11 under 35 U.S.C. § 103(a) as obvious over Jacquemoud,[3] Orr,[4] and Hansen[5] (Final Act. 10–13).

B. The Examiner rejected claims 1, 12–15, 24, 25, and 29–31 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, and Stewart[6] (Final Act. 13–15).

C. The Examiner rejected claims 1, 16–18, 24, 26–28, and 32 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, Stewart, and Halfhill[7] (Final Act. 15–17).

D. The Examiner rejected claims 19 and 21 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, and Anser[8] (Final Act. 17–18).

E. The Examiner rejected claims 22 and 23 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, Anser, and Free[9] (Final Act. 18–20).

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[3] Jacquemoud et al., *Comparison of Four Radiative Transfer Models to Stimulate Plant Canopies Reflectance: Direct and Inverse Mode*, 74 REMOTE SENSING ENV'T 471–81 (2000)

[4] Orr et al., US 5,764,819, issued June 9, 1998

[5] Hansen et al., *Reflectance measurement of canopy biomass and nitrogen status in wheat crops using normalized difference vegetation indices and partial least squares regression*, 86 REMOTE SENSING ENV'T 542–53 (2003)

[6] Stewart Jr., *Monitoring the presence and expression of transgenes in living plants*, 10 TRENDS IN PLANT SCI. 390–96 (2005)

[7] Halfhill et al., *Additive transgene expression and genetic introgression in multiple green-fluorescent protein transgenic crop × weed hybrid generations*, 107 THEOR. APPL. GENET. 1553–40 (2003)

[8] Anser et al., *Drought stress and carbon uptake in an Amazon forest measured with spaceborne imaging spectroscopy*, 101 PROC. NAT'L ACAD. SCI. 6039–44 (2004)

[9] Free, US 2006/0190137 A1, published Aug. 24, 2006

F. The Examiner rejected claim 20 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, Anser, and Cheng[10] (Final Act. 20–21).

G. The Examiner rejected claims 1–32 under 35 U.S.C. § 101 as directed to an abstract idea (Final Act. 5–9).

A–F. 35 U.S.C. § 103(a)

Because these rejections all rely on the combination of Jacquemoud, Orr, and Hansen, and because Appellants do not separately argue limitations in the dependent claims to which rejections B-F are addressed, we will consider all of the rejections together.

The Examiner finds Jacquemoud teaches "a process of using reflectance spectra measurements of plant populations to develop inverse models for determining chlorophyll content and leaf area index" (Final Act. 11). The Examiner finds that Jacquemoud teaches "three validated inverse models were applied to field spectroscopic measurements of soybean and corn plants" (Final Act. 12). The Examiner finds that Jacquemoud does "not show selecting a second plant for breeding, measuring spectroscopic absorbance data and a corresponding measured plant characteristic from the same plant population, or partial least square regression analysis" (*id.*).

The Examiner finds Orr teaches "remote sensing to select plants for breeding" (Final Act. 12). The Examiner finds Hansen teaches "hyperspectral reflectance data was used to determine plant characteristics, and that partial least squares regression improved the prediction of some

[10] Cheng et al., *A Novel Integrated PCA and FLD Method on Hyperspectral Image Feature Extraction for Cucumber Chilling Damage Inspection*, 47 Am. Soc. Agric. Engineers 1313–20 (2004)

characteristics" (*id.*). The Examiner finds Hansen teaches measuring canopy reflectance using a spectrophometer and sampling the analyzed plants to assay plant characteristics (*see id.)*. The Examiner further finds that Hansen teaches a "multivariate analysis of the plant spectra" using multiple wavelengths (*id.*).

The Examiner determines it would have been:

> obvious to modify the spectral data used by Jacquemoud [] to include a partial least squares regression analysis because Hansen [] shows that partial least squares regression analysis produces equivalent or better results for a number of measured plant characteristics, and to perform spectroscopic and plant characteristic analysis on the same plants because Hansen [] shows developing a predictive model by use of those techniques, and because it is obvious to use a known technique to improve a similar method

(App. Br. 13).

The issue with respect to this rejection is: Does a preponderance of the evidence of record support the Examiner's conclusion that claim 1 would have been obvious?

Findings of Fact ("FF")

1. Jacquemoud teaches comparing existing models for remote sensing in agriculture using model inversion by iterative optimization (Jacquemoud 471).

2. Jacquemoud teaches the successful testing of "[n]ew methods to extract information from remote sensing data, such as multispectral analysis, lookup tables, [] neural networks" and "model inversion by iterative optimization techniques" (Jacquemoud 471–472).

3. Jacquemoud teaches that there are several critical elements for a successful model, including: physical meaning, good fit, running time on a given computer, and input parameters representing quantities measureable in the field and interpretable in terms of plant biophysical characteristics (*see* Jacquemoud 472).

4. Jacquemoud teaches testing the models against synthetic data and field data, including remote sensing of 20 soybean and 20 corn parcels (*see* Jacquemoud 476–477 "About 20 soybean (*Glycine max*) and 20 corn (*Zea mays* L.) parcels were overflown by CASI on five different dates covering the growing season, giving rise to an impressive data set, with 200 spectra available together with some canopy biophysical characteristics like the green LAI or Cab· LAI and Cab.")

5. Orr teaches classifying plants by remote sensing and image analysis technology for "evaluating plants and for selecting plants for a plant breeding program" (Orr Abstract).

6. Orr teaches a classifying method including the steps of:

> 1. Simultaneously collect remote sensing data in the form of an image on a first set of phenotypic traits from a group of plant genotypes of the same species generally from relatively small geographical areas, in particular, subplots of land in which plants are growing . . . .
>
> In some cases, one may wish to obtain information on the environment (E) in which the plants are growing so that the genotypic effects (G) can be separated from the total phenotype (P) where (P=G+E).
>
> 2. Develop a descriptor by performing operations on the raw data obtained by remote sensing.

> 3. Use the descriptor to classify the plants; the descriptor may also be used to predict values for a second set of commercially valuable traits.

(Orr 5:21–40).

7. Hansen teaches "[h]yperspectral reflectance (438 to 884 nm) data were recorded at five different growth stages of winter wheat in a field experiment" (Hansen Abstract).

8. Hansen teaches that partial least squares regression ("PLS") "may provide a useful exploratory and predictive tool when applied on hyperspectral reflectance data" (Hansen Abstract).

9. Hansen teaches:

> The objective of the present investigation was to compare the predictive power of (i) models based on predefined short and broadbands for a normalized difference type of index, (ii) the best combination of narrow wavebands for a normalized difference type of vegetation index, and (iii) partial least squares regression (PLS) using all available wavebands

(Hansen 543).

10. Hansen teaches an experimental design that coordinated measurements of canopy reflectance with an effective measurement range of 438–833 nm, with corresponding green plant samplings to measure green biomass ("GBM"), nitrogen concentration ("N_{conc}") and density ("$N_{density}$"), and chlorophyll concentration ("Chl_{conc}") and density ("$Chl_{density}$") (*see* Hansen 544).

11. Hansen teaches planning a wide range of investigated crop variables, as shown in Table 1, "in order to make the relationship between

plant performance and reflectance measurements (Fig. 1) as realistic and universal as possible" (Hansen 544, 547).

12. Hansen teaches "PLS is a bilinear calibration method using data compression by reducing the large number of measured collinear spectral variables to a few non-correlated principal components (PCs). The PCs represents [sic] the relevant structural information, which is present in the reflectance measurements to predict the dependent variable" (Hansen 546).

13. Hansen teaches "[t]he performance of the best of the selected indices was compared to that obtained in a multivariate calibration based on [PLS] . . . PLS improved the models related to GBM with 22%, $Chl_{density}$ 4%, N_{conc} 24%, and $N_{density}$ 3% as compared to exponential fitting us[ing] the selected narrowbands (Table 4)" (Hansen 549–550).

14. Hansen teaches "[t]he present work represents an initial step in evaluating [PLS] compared to vegetation indices. The PLS models performed equally or better . . . compared to the best of the selected indices . . . showing that PLS indeed is a potentially useful method" (Hansen 551–552).

15. Hansen teaches:

> selection of two narrow bands used for a [normalized difference vegetation index (NDVI)] leaves out valuable information which could contribute to a better explanation of the relation between spectral reflectance data and specific crop variables, while this information is still included in the PLS models. Consequently, PLS provides a useful explorative tool for interpretation of the relationship between canopy spectral reflectance and crop variables.

(Hansen 552).

16. Cheng teaches an integrated principal component analysis ("PCA") and Fisher's linear discriminant ("FLD") method for multivariate analysis of hyperspectral images of fruits and vegetables (*see* Cheng Abstract).

17. Cheng teaches an experimental design that calibrated hyperspectral measurements of scanned wavelengths from 447.3 nm to 951.2 nm, for a total of 112 spectral bands, with corresponding image samples of good and injured cucumbers (*see* Cheng 1315, 1318).

Principles of Law

"The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398,416 (2007).

"[C]laims in an application are to be given their broadest reasonable interpretation consistent with the specification and that claim language should be read in light of the specification as it would be interpreted by one of ordinary skill in the art." *In re Sneed*, 710 F.2d 1544, 1548 (Fed. Cir. 1983).

Analysis

We agree with the Examiner that the combination of Jacquemoud, Orr and Hansen renders claim 1 obvious (Final Act. 10–21; FF 1–15) and we adopt the Examiner's position as our own. We consider Appellants arguments below.

Appellants contend the examiner "(1) did not meet his burden to identify . . . a teaching or suggestion of every limitation of appellants' claims and (2) could arrive at appellants' claims only by making impermissibly drastic modifications to the cited art" (App. Br. 23). Appellants focus their discussion on Jacquemoud (*see* App. Br. 23–27). For example, Appellants argue that Jacquemoud describes classical models that "operate using a set of pre-determined parameters" contrasting with Appellants' claimed invention that "operates by starting with a *de novo* calibration that relates measured plant characteristics data sets with one or more spectral features" (App. Br. 24). Appellants further argue "[g]iven the qualitative differences between applicants' methods and Jacquemond's [sic] classical methods, one could not arrive at applicants' claimed methods without making wholesale changes to Jacquemond's [sic] methods, as Jacquemond [sic] does not mention performing any *de novo* calibrations" (*id.*) (*italics added*).

We do not find this argument persuasive because the claims do not recite a "*de novo*" calibration. Appellants argue the "specification explains that predictive models are *de novo* models, and it is well-settled that claims are read in light of the specification." (Reply Br. 12) (*italics added*). However, the Specification does not limit predictive models to *de novo* models. Rather, the Specification states that "[m]any existing predictive models are 'classical' or 'reverse' models in that one starts with certain *a priori* information . . ." (Spec. ¶ 5). Appellants do not direct us to any express definition or similar requirement in the Specification that the claimed "predictive model" is a "*de novo*" model. "[W]hile it is true that claims are to be interpreted in light of the specification . . . , it does not follow that limitations from the specification may be read into the claims. . . . [T]he claims define the invention." *Sjolund v. Musland*, 847 F.2d 1573, 1581–82 (Fed. Cir. 1988). In the absence of the actual term in the claim language and any express definition in the Specification, we are not persuaded that the claims require a *de novo* calibration as argued by Appellants.

Appellants argue that "Jacquemond [sic] does not create any predictive models — instead, Jacqumond [sic] is simply inverting existing models on data sets to judge the robustness of those models" (Reply Br. 13). Appellants further argue that "the examiner does not identify in Jacquemond [sic] the claimed limitation of using whole-plant spectra" (App. Br. 26).

We do not find these arguments persuasive because Appellants are arguing against Jacquemoud individually rather than the combination with Orr and Hansen as a whole. "Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of a combination of references . . . . [The reference] must be read, not in isolation, but for what it fairly teaches in combination with the prior art as a whole." *In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986). As presented by the Examiner, Hansen teaches performing a multivariate calibration constructed from spectroscopic measurements of plants and corresponding measured plant characteristics obtained by plant sampling (FF 7–13). Moreover, Hansen teaches that multivariate calibration by PLS uses all available wavebands, unlike preexisting models (FF 9). Because the combination of Jacquemoud, Orr, and Hanson teaches every limitation of the claims, we are not persuaded that the Examiner erred.

Appellants argue that Jacquemoud teaches away from the claims by stating "that an analysis of a plant must begin with the selection of a 'good' pre-existing, classical model" (App. Br. 26). However, Jacquemoud does not criticize, discredit, or otherwise discourage the use of other models, specifically acknowledging alternatives such as multispectral analysis, lookup tables, and neural networks (*see* FF 2). "The prior art's mere disclosure of more than one alternative does not constitute a teaching away from . . . alternatives because such disclosure does not criticize, discredit, or otherwise discourage the solution claimed." *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004). Moreover, Appellants focus on Jacquemoud individually rather than the combined prior art. As explained by the Examiner, Hansen provides a reason to use multivariate calibration as a PLS model performs better than known models without leaving out valuable information (FF 13, 14). Because the prior art does not teach away and rather provides an express reason to combine the references, we are not persuaded that the Examiner has erred.

Appellants argue that "the examiner's other references do not cure Jacquemond's [sic] deficiencies of (1) failing to utilize whole-plant spectra and (2) failing to construct *de novo* models based on the whole-plant spectra" (App. Br. 27). However, as discussed above, Hansen teaches a predictive model applying PLS multivariate calibration using all available wavebands (FF 8). Therefore, we are not persuaded that the Examiner erred in determining that claim 1 would have been obvious over the prior art.

As to claims 2–32, Appellants rely upon their arguments regarding claim 1 (*see* App. Br. 28–29). Because we find those arguments unpersuasive, we also find the repetition of the same arguments for claims 2–32 unpersuasive.

Conclusion of Law

A preponderance of the evidence of record supports the Examiner's conclusion that claims 1–32 would have been obvious.

G. *35 U.S.C. § 101*

The Examiner finds all of the claims unpatentable under 35 U.S.C. § 101 as being directed to patent-ineligible subject matter (Final Act. 5–9). Specifically, the Examiner finds that the claims are directed to "the abstract idea of comparing information regarding a sample or test subject to a control or target data at issue in *Univ. of Utah Res. Found. v. Ambry Genetics Corp.*, 774 F.3d 755 (Fed. Cir. 2014)" (Final Act. 5). The Examiner further finds "[t]he claimed process and computer use a model that is an algorithm that analyzes abstract data on a generic computer" (Ans. 3).

Appellants argue that the claims are not directed to a judicial exception and instead are directed to "a specific improvement to the way in which users may estimate a characteristic of interest in a plant" supported by the specification which "explains still further advantages that the claimed technology provides over existing approaches" (App. Br. 15–16).

Analysis

To determine whether a claim is invalid under § 101, we employ the two-step *Alice* framework. In *Alice* step one, we ask whether the claims are directed to a patent ineligible concept, such as an abstract idea or law of nature. *Alice Corp. Pty. V. CLS Bank Int'l*, 134 S.Ct. 2347, 2355 (2014). Although method claims are generally eligible subject matter, method claims that are directed only to abstract ideas and/or natural phenomena are directed to patent ineligible concepts. *Ariosa Diagnostics, Inc. v. Sequenom, Inc.*, 788 F.3d 1371, 1376 (Fed. Cir. 2015). In *Alice* step two, we examine the elements of the claims to determine whether they contain an inventive concept sufficient to transform the claimed judicial exception into a patent-eligible application. *Mayo Collaborative Services v. Prometheus*

Laboratories, Inc., 566 U.S. 66, 71–72 (2012) (quoting *Alice*, 134 S.Ct. at 2355).

The PTO recently published revised guidance on the application of § 101. USPTO's January 7, 2019 Memorandum, *2019 Revised Patent Subject Matter Eligibility Guidance,* 84 Fed. Reg. 50–57 (2019) ("2019 Guidelines"). Under that guidance, we first look to whether the claim recites:

> (1) any judicial exceptions, including certain groupings of abstract ideas (i.e., mathematical concepts, certain methods of organizing human activity such as a fundamental economic practice, or mental processes); and
>
> (2) additional elements that integrate the judicial exception into a practical application (*see* MPEP § 2106.05(a)–(c), (e)–(h)).

See 84 Fed. Reg. 54–55. Only if a claim (1) recites a judicial exception and (2) does not integrate that exception into a practical application, do we then look to whether the claim:

> (3) adds a specific limitation beyond the judicial exception that are not "well-understood, routine, conventional" in the field (*see* MPEP § 2106.05(d)); or
>
> (4) simply appends well-understood, routine, conventional activities previously known to the industry, specified at a high level of generality, to the judicial exception.

See 84 Fed. Reg. 51.

Claim 1

Applying *Alice* step one, we look to see if the claim recites any judicial exceptions. First, we find the claim recites a predictive model based on a mathematical concept, specifically, a calibration constructed from two data sets, the calibration being a multivariate relation maximizing covariance between data sets. As described by the Specification, "spectra information obtained from [remote sensing] is subjected to at least one mathematical transformation to arrive at an analyte concentration or characteristic prediction value" (Spec. ¶ 135). The Specification further cites to textbook examples of calibration methods including PLS and principal component analysis ("PCA") (*see* Spec. ¶ 143–149). Both are known mathematical algorithms for statistical analysis. *See also, SAP America, Inc. v. InvestPic, LLC*, 898 F.3d 1161, 1166 (Fed. Cir. 2018) ("The court concluded that the claims . . . are directed to 'performing statistical analysis,' specified using words in the claims and using more technical, mathematical notation in the written description"). Therefore, we determine that the claim recites a mathematical concept in the abstract idea category of judicial exceptions.

Second, we find that the claim recites a process of collecting and analyzing data, specifically absorbance data and measured plant characteristic data, and then applying the result of the analysis. As explained by our reviewing court, "analyzing information by steps people go through in their minds, or by mathematical algorithms, without more, [are treated] as essentially mental processes within the abstract-idea category." *Elec. Power Grp., LLC* v. *Alstom S.A.*, 830 F.3d 1350, 1354 (Fed. Cir. 2016). Because claim 1 recites collection and analyzing information by mathematical algorithms, we find claim 1 recites a mental process in the abstract idea category of judicial exceptions.

A claim that recites a judicial exception requires further analysis to determine if any additional elements integrate the judicial exception into a practical application. *See* 84 Fed. Reg. 54. The 2019 Guidelines explain that additional elements that integrate the judicial exception into a practical application include applying the judicial exception in some meaningful way beyond generally linking the use of the judicial exception to a particular technological environment. (*See* 84 Fed. Reg. 55, citing *Diamond v. Diehr,* 450 U.S. 175, 184 (1981)). For example, the claims in *Diehr* recited a method for operating a rubber-molding press including the step of "opening the press automatically when said comparison [of calculated cure time vs. elapsed time] indicates equivalence." *See Diehr*, 450 U.S. 179 n.5.

Applying the *Diehr* reasoning consistent with the 2019 Guidelines, claim 1 at issue recites the step of: "selecting or removing the second plant for use in a plant breeding program based on the second plant's estimated plant characteristic." Following *Diehr*, we determine that claim 1 integrates the judicial exceptions into the practical application of plant breeding because this step results in the physical process of breeding particular plants. The "selecting or removing" physical step in claim 1 is analogous to the *Diehr* step of opening the press because both require a specific, practical physical act in a particular technological environment that extends the methods beyond mental steps or mathematical analysis. Because we conclude that the judicial exceptions recited in claim 1 are integrated into the practical application of plant breeding, we conclude that claim 1 is directed to patent-eligible subject matter.

Claims 19, 20, 21, 22, and 24

Alice Step One

Independent claims 19, 20, 21, 22, 24 recite similar judicial exceptions to claim 1, specifically a predictive model incorporating mathematical concepts, e.g., a calibration being a multivariate function maximizing covariance, and mental processes, e.g., collecting and analyzing data sets. Therefore, we examine the claims for any additional elements that integrate the judicial exceptions into a practical application.

Claims 19, 21, and 24 each recite the step of "applying the predictive model to whole-plant spectroscopic data collected from a second plant" to estimate drought tolerance, a characteristic's presence, or a level of genome introgression in the second plant, respectively. This additional step applies the judicial exception, i.e., a predictive model based on the abstract idea of a series of mathematical calculations analyzing selected information, to generate new data, e.g., estimate drought tolerance, characteristic's presence, or genome introgression. However, "[w]ithout additional limitations, a process that employs mathematical algorithms to manipulate existing information to generate additional information is not patent eligible." *Digitech Image Techs. v. Electronics for Imaging, Inc.*, 758 F.3d 1344, 1351 (Fed. Cir. 2014). Unlike claim 1, claims 19, 21, and 24 do not recite any additional elements to integrate the judicial exception into a practical application.

Nor do these steps function to improve the computer process itself as in *McRO, Inc. v. Bandai Namco Games Am. Inc.*, 837 F.3d 1299 (Fed. Cir. 2016). While Appellants compare the improvement in computer animation in *McRO* to the instant claims (*see* App. Br. 16), we find the comparison unpersuasive. In *McRO*, the method integrated specific process steps of phoneme analysis to obtain facial expression control of animated characters, thereby integrating the improvement into the animation process. *See McRO*, 837 F.3d at 1315. Claims 19, 20, 21, 22, and 24 do not integrate the process steps into a practical improvement because their final steps simply generate data for further consideration. *See Elec. Power Grp.*, 830 F.3d at 1355 "[M]erely selecting information, by content or source, for collection, analysis, and display does nothing significant to differentiate a process from ordinary mental processes.")

We are also unpersuaded by Appellants' reliance on *Enfish, LLC v. Microsoft Corp.*, 822 F.3d 1327 (Fed. Cir. 2016). *Enfish* explains that "the first step in the *Alice* inquiry in this case asks whether the focus of the claims is on the specific asserted improvement in computer capabilities . . . or, instead, on a process that qualifies as an 'abstract idea' for which computers are invoked merely as a tool." *Enfish*, 822 F.3d at 1335–6. Applied to claims 19, 21 and 24, these methods do not teach a technical improvement in a computer processor, but rather use the computer as a tool to improve data analysis (*see, e.g.*, claims 19, 21, and 24).

Therefore, we determine claims 19, 21, and 24 are directed to a judicial exception.

Claim 20 recites the additional step of "generating a vector of calibration coefficients where said vector constitutes said predictive model and wherein a specific number of factors models at least one region of a spectrum." This step merely recites an additional mathematical concept appended to the previously recited judicial exceptions. Therefore, we determine claim 20 is also directed to a judicial exception.

Claim 22 recites a system for estimating a plant characteristic that includes a device capable of storing data, a memory unit, and a computing device capable of relating a portion of spectroscopic absorbance data to a measured value of a plant characteristics by the predictive model of claim 1.

Here, we find that "incidental use of a computer to perform the mental process of claim [22] does not impose a sufficiently meaningful limit on the claim's scope." *CyberSource Corp. v. Retail Decisions, Inc.*, 654 F.3d 1366, 1375 (Fed. Cir. 2011). Therefore, claim 22 does not recite any additional elements to integrate the judicial exception into a practical application, and we determine the claim is directed to a judicial exception.

Alice Step Two

Because we determine that claims 19, 20, 21, 22, and 24 are directed to judicial exceptions, we apply *Alice* step two to evaluate whether the claim provides an inventive concept, i.e., whether the additional elements amount to significantly more than the exception itself. (*See* 2019 Guidelines, 84 Fed. Reg. at 56) The Examiner finds "the instant claimed subject matter does not include unconventional additional elements or an unconventional combination of additional elements as discussed in the rejection" (Ans. 5).

Appellants argue that "an inventive concept can be found in the non-conventional and non-generic arrangement of known, conventional pieces" citing *Bascom Global Internet Serv., Inc. v. AT&T Mobility LLC*, 827 F.3d 1341, 1350 (Fed. Cir. 2016). Appellants argue that the Specification:

> identif[ies] a number of significant improvements that the claimed technology provides, including: [1] quicker model construction than existing techniques; [2] no need for *a priori* knowledge; [3] can be used on single or multiple plants; [4] can handle various data table sizes; [5] permits good results even in the presence of interference; and further advantages. Every one of these represents an improvement over existing technologies, and it is precisely these kinds of improvements that the Federal Circuit recognized in *Bascom* as supporting a conclusion of patent eligibility at Step 2 of the *Alice* analysis.

(App. Br. 22). Furthermore, Appellants argue "the claimed methods utilize whole-plant spectra as inputs, which unconventional approach represents a significant departure from the prior art's usage of pure-component (as opposed to whole-plant) spectra" (*id.*)

We are not persuaded by Appellants' arguments. Our reviewing court in *Bascom* found the patent claimed "a technology-based solution (not an abstract-idea-based solution implemented with generic technical components in a conventional way) to filter content on the Internet that overcomes existing problems with other Internet filtering systems." *Bascom*, 827 F.3d at 1351. Unlike *Bascom*, claims 19, 20, 21, 22, and 24 recite an abstract-idea-based solution, i.e., a predictive model incorporating mathematical concepts and mental processes. Moreover, as explained by the Specification, the abstract-idea-based solution is implemented with generic technical components in a conventional way by using generic computers, commercially available software, and known mathematical techniques (*see* Spec. ¶¶ 100, 103, 179–183). Unlike *Bascom*, the invention at issue is not "a software-based invention that improves the performance of the computer system itself." 827 F.3d at 1351.

As to Appellants' arguments that using whole-plant spectra inputs represents an unconventional approach from the prior art, we find that the prior art teaches the uses of whole-plant spectra inputs. We have addressed the teachings of Hansen at length as to obviousness above. We further find that Cheng also teaches a calibration based on whole-plant spectroscopic absorbance data as opposed to pure-component spectra (FF 15–16). Because the prior art teaches calibration including whole-plant spectra, we find that the use of whole-plant spectral analysis was a well-understood, routine and conventional activity. *See Berkheimer v. HP, Inc.*, 881 F.3d 1360, 1368 (Fed. Cir. 2018).

Conclusion of Law

We conclude that claims 19–32 are directed to patent-ineligible subject matter.

SUMMARY

In summary, we reverse the rejection of claims 1–18 under 35 U.S.C. § 101.

We affirm the rejection of claims 19–32 under 35 U.S.C. § 101.

We affirm the rejection of claims 1–11 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, and Hansen.

We affirm the rejection of claims 1, 12–15, 24, 25, and 29–31 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, and Stewart.

We affirm the rejection of claims 1, 16–18, 24, 26–28, and 32 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, Stewart, and Halfhill.

We affirm the rejection of claims 19 and 21 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, and Anser.

We affirm the rejection of claims 22 and 23 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, Anser, and Free.

We affirm the rejection of claim 20 under 35 U.S.C. § 103(a) as obvious over Jacquemoud, Orr, Hansen, Anser, and Cheng.

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a).

AFFIRMED